CLAIMS

What is claimed are:

Sub a8

1. The internet protocol over wavelength division multiplexing (WDM) network structure comprising:

a plurality of sub-ring for connecting n number of terminals (where n is a positive integer) to which unique user wave lengths are respectively allocated;

a main ring for connecting n number of connection nodes connecting sub-rings to which unique user wave lengths are respectively allocated;

a single sub-ring controller connected to said single sub-ring and said main ring, and controlling the flows of a packet transmitted/received inside said sub-ring and a packet transmitted/received between said sub-ring and said main ring; and

a main ring controller for controlling the flow of a packet transmitted/received inside said main ring,

wherein said terminals and connection nodes each add/drop only their own unique wavelength signals,

said sub-ring controller and main ring controller drop all the wavelength division multiplexed signals to de-multiplex the signals, load each of said signals on their unique user wavelengths in their destination terminals, and then multiplex again said signals to transmit to said sub-ring and main ring, and

said sub-ring controller adds the identifying code (which is called a λ tag) of the sub-ring having a destination terminal, to the transmitted packet, and then transmits it to said main ring.

2. The internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, wherein the number of the sub-rings connected to

said main ring and the number of the terminals connected to one sub-ring are same (m=n), the n number of wavelengths ($\lambda_1 \sim \lambda_n$) allocated to each of the sub-rings in the main ring, and the n number of wavelengths ($\lambda_1 \sim \lambda_n$) allocated to each of the terminal in a given sub-ring are shared, whereby the n^2 number of terminals are supported by the n number of wavelengths ($\lambda_1 \sim \lambda_n$).

3. The internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, wherein said terminals and connection nodes include a wavelength coupler for adds/drops only its own unique user wavelengths.

Sub a8 4. The internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, wherein said wavelength coupler includes an input circulator, a fiber Bragg grating for reflecting an unique user wavelength from a corresponding terminal and for passing other wavelengths, and an output circulator,

said input circulator transfers the wavelength division multiplexed signal inputted via said sub-ring to said fiber Bragg grating and drops the unique user wavelength from the corresponding terminal, that is reflected by said fiber Bragg grating,

said output circulator transfers the signal added at the corresponding terminal to said output terminal of said fiber Bragg grating and transmits said signal along with the signal passed through said fiber Bragg grating to said sub-ring.

5. In a sub-ring controller, an internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, comprising:

a de-multiplexing means for dropping the wavelength division multiplexed signals passing through said sub-ring by wavelengths to de-multiplex the wavelength division multiplexed signals;

a routing means for establishing the path of the de-multiplexed packet by the destination terminal, using the destination terminal address included in the packet;

a packet grouping means for grouping the packet for which its path is established by its destination terminal;

a wavelength allocating means for loading said packet grouped by its path on the unique user wavelengths of said destination terminals; and

a wavelength multiplexing means for multiplexing all the wavelength transformation signals for all the destination terminals to transmit the multiplexed signals to said sub-ring.

6. An internet protocol over wavelength division multiplexing (WDM) network structure according to claim 5, wherein said packet grouping means include at least n number of buffers for storing the packets discriminated by their destinations in said routing means.

~~7. An internet protocol over wavelength division multiplexing (WDM)~~ network structure according to claim 5, wherein said sub-ring controller includes:

a λ tag attachment means for attaching the λ tag according to the path of the packet determined by said packet routing means;

a frame means for combining said λ tag and said packet to expand the combined packet with a determined transmission packet;

a wavelength controller for transforming said expanded packet into its own unique user wavelength; and

a light transmitter for transmitting into its own unique user wavelength signal of said expanded packet to said main ring.

8. An internet protocol over wavelength division multiplexing (WDM) network structure according to claim 5, wherein said sub-ring controller includes:

an optical receiver for receiving the unique user wavelength signal from said main ring;

a reframe means for synchronizing said received signal and for receiving the packet including CRC (cyclic redundancy check); and

a λ tag delineating means for delineating said λ tag to transmit the packet to the routing means.

9. An internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, comprising:

a λ-tag delineator for delineating a destination sub-ring using the λ-tag added to the packets;

a λ-tag based switching section for distributing the packets by their destinations according to the λ-tag of the destination terminal;

at least n number of buffers for storing the packets distributed according to the destination at said λ-tag based switching section;

at least n number of lead frame sections for reading the packets from each of the buffers and for adding the λ-tag corresponding to said destination; and

the n number of transmitters for reading the packets from each of said buffers to transmit the packets with optical signals having wavelengths allocated to said destination.

10. The internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, wherein said main ring is extended horizontally by connecting n number of said connection nodes of said main ring and n number of connection nodes of another main ring by means of gateway controller,

a transmitting part of said sub-ring controller adds an identifying code (λ-tag) of the connection node to a packet for transmitting, and then transmits it to a transmitting part of said main ring,

said gateway controller transforms an identifying code of said packet into identifying codes of said connection nodes connected with a receiving part of said sub-ring, and then transmits it to a receiving part of said main ring.

11. An internet protocol over wavelength division multiplexing (WDM) network structure according to claim 1, wherein a plurality of intermediate rings connected with the plurality of said sub-rings make a structure of a three-layer structure by connecting with said main ring, said intermediate ring having intermediate ring controllers for controlling a path of the packet transmitted from said sub-rings or said main ring,

said sub-ring controller adds identifying code of the intermediate ring having destination terminal and identifying code of said sub-ring, to the packet for transmitting, and then transmits extended packet,

said intermediate ring controller confirms identifying code of said intermediate ring included in the extended packet transmitted from said sub-ring, and if a state of the identifying code is null, said intermediate ring controller confirms identifying code of said sub-ring, and then transmits said extended packet to said sub-ring having said destination terminal, and if the state is not null, it transmits said extended packet to said main ring, and

said main controller confirms identifying code of said intermediate ring included in the extended packet transmitted from said intermediate ring, and then changes said identifying code of said intermediate ring into a null state, and then transmits said extended packet to said intermediate ring having said destination terminal.

~~12. A sub-ring controller, in an internet protocol over wavelength division~~ multiplexing network structure including the n number of terminals (where n is a positive integer) to which unique user wavelengths are respectively allocated, and a sub ring for connecting the n number of terminals in a ring shape, comprising:

a de-multiplexing means for dropping the wavelength division multiplexed signals passing through said sub-ring by wavelengths to de-multiplex the wavelength division multiplexed signals;

a routing means for establishing the path of the de-multiplexed packet by the destination terminal, using the destination terminal address included in the packet;

a packet grouping means for grouping the packet for which its path is established by its destination terminal;

a wavelength allocating means for loading said packet grouped by its path on the unique user wavelengths of said destination terminals; and

a wavelength multiplexing means for multiplexing all the wavelength transformation signals for all the destination terminals to transmit the multiplexed signals to said sub-ring.

13. The sub-ring controller according to claim 12, wherein said packet grouping means include at least n number of buffers for storing the packets discriminated by their destinations in said routing means.

14. The sub-ring controller according to claim 12, wherein the internet protocol over wavelength division multiplexing (WDM) network includes:

a main ring along which the path of the wavelength division multiplexing signal transverses, and

a sub-ring connected via said sub-ring controller to a plurality of connection nodes in said main ring to which unique user wavelengths are allocated, respectively,

said sub-ring controller for adding an unique user wavelength information (λ tag) on the destination sub-ring to a packet to be transmitted from its own sub-ring to other sub-ring and then for transmitting the packet to said main ring, in order to communicate with other sub-rings connected to said main ring, includes:

a λ tag attachment means for attaching the λ tag according to the path of the packet determined by said packet routing means;

a frame means for combining said λ tag and said packet to expand the combined packet with a determined transmission packet;

a wavelength controller for transforming said expanded packet into its own unique user wavelength; and

a light transmitter for transmitting into its own unique user wavelength signal of said expanded packet to said main ring.

15. The sub-ring controller according to claim 8, wherein the internet protocol over wavelength division multiplexing (WDM) network includes:

a main ring along which the path of the wavelength division multiplexing signal transverses, and

a sub-ring connected via said sub-ring controller to a plurality of connection nodes in said main ring to which unique user wavelengths are allocated, respectively,

said sub-ring controller for delineating a λ tag from the signal received from said main ring to transmit the signal to the destination terminal, in order to communicate with other sub-rings connected to said main ring includes:

an optical receiver for receiving the unique user wavelength signal from said main ring;

a lead frame means for synchronizing said received signal and for receiving the packet including CRC (cyclic redundancy check); and

a λ tag delineating means for delineating said λ tag to transmit the packet to the routing means.

16. A main ring controller for receiving an extended packet to which a λ tag is attached from a source sub-ring controller to transmit the packet to a destination sub-ring controller, comprising:

a λ-tag delineator for delineating a destination sub-ring using the λ-tag added to the packets;

a λ-tag based switching section for distributing the packets by their destinations according to the λ-tag of the destination terminal;

at least n number of buffers for storing the packets distributed according to the destination at said λ-tag based switching section;

at least n number of lead frame sections for reading the packets from each of the buffers and for adding the λ-tag corresponding to said destination; and

the n number of transmitters for reading the packets from each of said buffers to transmit the packets with optical signals having wavelengths allocated to said destination.

Sub a8 17. A method of transmitting/receiving packets in a sub-ring controller for controlling transmission/reception of the packets between any two of terminals, in an internet protocol over wavelength division multiplexing (WDM) network including the n number of terminals (where n is a positive integer) to which unique user wavelengths are respectively allocated, comprising the steps of:

if a source terminal transmits packets containing destination terminal addresses on their own unique user wavelengths, routing the paths of the packets by the destination terminal addresses using the destination terminal addresses contained in the packets;

grouping the packets to be transmitted to the destination terminals; and

loading the grouped packets on the unique user wavelengths of the destination terminals and then transmitting the packets to the sub-ring, whereby said destination terminal drops said grouped packets.

~~18. The method of transmitting/receiving packets in an internet protocol over~~ wavelength division multiplexing network according to ~~claim 17~~, wherein said routing step including delineating the packets by their destination terminals,

said grouping step including temporarily storing the packets in the buffers allocated to the destination terminals of the packets.

Sub a9 19. The method of transmitting/receiving packets according to claim 17, wherein a plurality of connection nodes of sub-ring connected via a main ring along which the path of the wavelength division multiplexing signal transverses,

the method in said sub-ring controller for adding an unique user wavelength information (λ tag) on the destination sub-ring to the packet to be transmitted from its own sub-ring to other sub-ring to transmit the packet to said main ring, includes:

a λ tag attachment step of attaching for attaching the λ tag according to the path of the packet determined at the step of routing the packet;

a frame step of combining the λ tag with the packet to expand the packet as a determined transmission packet;

a wavelength allocating step of loading the expanded packet on it own unique user wavelength; and

a light transmission step of transmitting the expanded packet loaded on its own unique user wavelength to the main ring.

20. The method of transmitting/receiving packets according to claim 17, wherein a plurality of connection nodes of sub-ring connected via a main ring along which the path of the wavelength division multiplexing signal transverses,

the method in said sub-ring controller for delineating the λ tag from the signal received from said main ring to transmit the signal to the destination terminal, includes:

a light receiving step of receiving the unique user wavelength signal from said main ring;

a reframe step of synchronizing the received signal and for receiving the signal including CRC; and

a λ tag delineating step of delineating the λ tag to transmit the packet to the routing step.

21. The method of transmitting/receiving packets according to claim 19, wherein the main ring controller for receiving the expanded packet to which the λ tag is attached from the source sub-ring to transmit the packet to the destination sub-ring, includes:

a λ-tag delineation step of delineating the destination sub-ring using the λ-tag contained in the packets inputted;

a λ-tag based switching step of distributing the packets by their destinations according to the λ-tag of the destination terminal;

a buffering step of storing the packets distributed according to the destination in said λ-tag based switching step on buffers;

a reframe step of reading the packets from the buffers and then for adding again a λ-tag corresponding to said destination; and

a transmission step of transmitting the lead framed packets with optical signals having wavelengths allocated to said destination.

22. An internet protocol over wavelength division multiplexing (WDM) network structure comprising:

the n number of terminals (where n is a positive integer) to which unique user wavelengths are respectively allocated;

a single controller for controlling the flow of a packet transmitted between two terminals; and

a ring network for connecting said n number of terminals and said single controller in a ring shape, wherein wavelength division multiplexed signals are transmitted along said ring network,

wherein said terminals each add/drop only their own unique user wavelength signals among the wavelength division multiplexed signals transmitted via said ring network, and

said controller drops all the wavelength division multiplexed signals transmitted via said ring network to de-multiplex the signals, loads each of said signals on their unique user wavelengths in their destination terminals, and then multiplexes again said signals to transmit to said ring network.

23. The internet protocol over wavelength division multiplexing (WDM) network structure according to claim 22, wherein any one terminal belonging to said ring network and any one terminal belonging to other ring network are connected, the same unique user wavelength is allocated to said two terminals, whereby as communication between said two ring networks are made possible via said two terminals, said ring networks are horizontally extended, respectively.

24. The internet protocol over wavelength division multiplexing (WDM) network structure according to claim 22, wherein said terminals includes a wavelength

coupler for adds/drops only its own unique user wavelengths, said wavelength coupler including an input circulator, a fiber Bragg grating for reflecting an unique user wavelength from a corresponding terminal and for passing other wavelengths, and an output circulator, wherein said input circulator transfers the wavelength division multiplexed signal inputted via said sub-ring to said fiber Bragg grating and drops the unique user wavelength from the corresponding terminal, that is reflected by said fiber Bragg grating, and said output circulator transfers the signal added at the corresponding terminal to said output terminal of said fiber Bragg grating and transmits said signal along with the signal passed through said fiber Bragg grating to said sub-ring.